RETROFITTING HIGH-RISE BUILDINGS WITH FIRE PROTECTION SPRINKLER SYSTEMS: ANALYZING THE COSTS AND BENEFITS FOR HALLANDALE BEACH, FLORIDA

EXECUTIVE DEVELOPMENT

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Abstract

The problem was that there are 38 high-rise buildings in the city of Hallandale Beach, Florida that have no automatic fire sprinkler system. The purpose of this research was to analyze the costs, benefits, and determine the steps necessary to comply with Florida State Statutes and implement a retrofitting program.

This was a descriptive research project. The research questions were:

1. What are the costs to the occupants and the community to retrofit fire protection sprinkler systems in high-rise buildings?
2. What are the benefits to the occupants and the community to retrofit fire protection sprinkler systems in high-rise buildings?
3. What steps are necessary to implement and comply with Florida State Statues concerning retrofitting fire protection sprinkler systems in high-rise buildings?

The research project methodology was primarily comprised of a literature review, survey instrument, and interviews with fire prevention specialists.

The results showed that instituting a fire sprinkler retrofit program in high-rise buildings, local communities and fire department organizations could attain significant cost reductions and life safety benefits.

The recommendation resulting from this research was that fire sprinkler systems should be installed in all high-rise buildings as soon as possible, because they present enormous potential benefits in life safety and property conservation, and also result in significant financial advantages. Fire departments, along with local, state and federal leaders, must embrace the concept of having fire sprinkler systems in all high-rise buildings and actively advocate this necessary type of fire protection through public education and awareness training.

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Introduction

The problem is that 38 buildings in the City of Hallandale Beach, Florida are over 75 feet high and have no automatic fire protection sprinkler systems. The purpose of this research is to analyze the costs and benefits of retrofitting automatic fire protection sprinkler systems in high-rise structures that are 75 feet and higher, located in Hallandale Beach, Florida. This is a descriptive research project that will utilize information from the National Fire Academy's Learning Resource Library, United States Fire Administration, State and Local government sources, fire sprinkler construction contractors, and Internet resources. The research questions are:

1. What are the costs to the occupants and the community to retrofit fire protection sprinkler systems in high-rise buildings?
2. What are the benefits to the occupants and the community to retrofit fire protection sprinklers systems in high-rise buildings?
3. What steps are necessary to implement and comply with Florida State Statues concerning retrofitting fire protection sprinklers systems in high-rise buildings?

Background and Significance

A cost-effective approach of requiring existing high rise buildings to retrofit automatic fire sprinkler systems has never been clearly developed. Building owners see this objective as an intrusion into their rights and readily accuse local governments of saddling them with perceived unfunded mandates. Owners believe it unfair to be required to bear the expense of retrofitting fire protection, when their buildings have stood the test of time and the requirement did not exist when the building was originally constructed.

At the present time there are 106 buildings over 5 stories in Hallandale Beach, Florida that have no automatic sprinkler systems; 38 of these are 75 feet or higher. Prior to 1983, the State of Florida and local governments did not have a statute that could be enforced concerning automatic sprinkler systems in residential high-rise building. This changed with the enactment of Florida Statue, *Chapter 553.895* B*uilding Construction Standards, Firesafety*. The new standard in 1983 only affected hotels, motels, timeshares, and any other type of transient public lodging that was three stories or higher and had interior corridors. (2001). Since January 1, 1994, fire protection sprinklers have been required for new construction in any new building having three stories or more, regardless of occupancy. Because most cities along South Florida's coast had been completely built out by the late 1960's and early 1970's, a majority of high-rise buildings did not incorporate fire sprinklers into their design and there were no legislative statutes compelling them to retrofit. Most of these structures are residential in nature and well above the 75-foot limit that is defined in *Florida Fire Prevention Code 633.0215* for high rise buildings. In the future, pending state legislation may require that all high-rise buildings 75' or higher be retrofitted with an automatic sprinkler system. New laws may require that systems are installed in the entire building or in part of the building, or they may allow occupants to determine whether or not to retrofit their building at all.

This applied research project (ARP) relates to Unit 11 Legal Issues that were taught in the Executive Development course. The Terminal Objective states "The student will be able to understand basic legal concepts and to consider the personal and organizational implications of decisions affecting fire service operations." It also states in Enabling Objective #2 that the student is "to identify common fire service issues and situations with significant legal implications" (NFA, 1998, p. SM 11-2).

The research project relates directly to United States Fire Administration operational objective "to promote within communities a comprehensive, multi-hazard risk-reduction plan led by the fire service organization" (NFA, 2002, p. II-2).

Literature Review

The intent of this literature review was to research and collect information relating to the cost, benefits and steps associated with compliance with the State of Florida fire sprinkler retrofit laws. The literature review revealed a large volume of information pertaining to costs associated with sprinkler installation, the benefits that can be produced, and the steps necessary to implement and comply with current and proposed legislation for the retrofitting of high-rise buildings.

Related costs can be broken down in many ways and must be shared by many stakeholders. These include installation costs, life safety issues, property damage reduction, building occupants, fire departments organizations, and the overall community. In an informational flier, the U.S. Fire Administration speculated that the costs of home sprinkler systems are approximately $1.00 per square foot in new construction. In Scottsdale, Arizona, the average cost is less than $.80 per square foot (FEMA, 1997). It must be noted that these estimates are for residential, single-family homes. High-rise buildings require a more complex installation, particularly in older buildings where access to mechanical systems is difficult and construction practices dated. This undoubtedly increases the overall costs for installing a fire sprinkler system.

Chief D. P. Sullivan, of Hallandale Beach Fire-Rescue, obtained figures on June 27, 2000 from several fire sprinkler and fire alarm contractors. These estimates indicated that sprinkler system costs in the City could average between $2.76 and $3.38 per square foot. These figures are documented in memorandum 8A/98 and consider that the average size of a condominium in a

Hallandale Beach high-rise is approximately 1,000 square feet. The elevated cost is attributable to, not only the fire sprinkler system, but also the required upgrades to the fire alarms, generators and the fire pumps that would also be required.

The high costs of these fire protection systems have been the principal obstacle to the adoption of residential sprinkler ordinances by local governments (Coleman & Granito, 1988). In many communities, developers and lobbyists have successfully defeated any retrofitting initiatives by arguing that the costs relating to the installation of sprinkler systems would make new home prices uncompetitive in the marketplace. Some communities have overcome these objections by offering trade-offs to developers and occupants. For example, they have:

- Relaxed other building code requirements and zoning ordinances that have higher costs,
- Reduced local fire tax millage rates,
- Allowed increased density in single-family developments, and
- Increased the spacing of fire hydrants from 500 ft to 1200 ft (RFSI, 2003).

Some undeniable costs associated with the absence of fire sprinklers are the potential loss of life and severe injuries that can result from fire incidents. The United States has one of the highest rates of fire loss and deaths in the industrialized world. Between 1979 and 1992, the United States Fire Administration studied the fire death rates of 14 industrialized nations. During this period, the United States fire death rate fell 46.3 percent, from 36.3 fire deaths per million population in 1979, to 19.5 fire deaths per million population in 1992. This equates to an average of 26.5 fire deaths per million population during the study's 13-year period (FEMA Trends, 1997).

Even with this remarkable drop in fire deaths during the study period, the U.S. fire rate is over five times that of Switzerland, the nation with the lowest rate of all countries considered in

this study (FEMA Trends, 1997). Figure 1 graphically illustrates the fire death rates of 14 countries and shows that the United States has one of the highest rates. The reality is that fire deaths could be reduced by an estimated 82% if residential fire sprinklers were installed along with smoke detectors (Ruegg & Fuller, 1984). Between 1985 and 1994, there were an average of 5,770 fire deaths per year in the United States. An 82% reduction rate means that over 4,700 people a year during this period could have survived (FEMA Trends, 1997). One study in Scottsdale, Arizona concluded that smoke detectors and sprinklers can reduce the loss of life by 98%, which is an increase of 48.5% over smoke detectors alone (Ford, 1997). This is a considerably higher figure than what was reported by Ruegg & Fuller in 1984.

The United States Fire Administration, National Fire Data Center, concluded that, "The installation of sprinklers provides significant protection against fire". However, this conclusion cannot be drawn from National Fire Incident Reporting System (NFIRS) data alone, since NFIRS considers properties of different sizes and values to be in the same property class (FEMA, 2001). To get around this problem, comparisons were made of losses in buildings with sprinklers that operated with buildings with sprinklers that didn't operate. In 1998, the losses per fire were nearly three times less when sprinklers operated than when they did not (FEMA, 2001).

Another cost related to the absence of sprinkler systems is direct property damage. In a study between 1989 and 1998, the National Fire Protection Association (NFPA) concluded that there were significant property damage reductions in structures having fire sprinkler systems. This is illustrated by the following examples of property damage levels:

- 53% for stores and offices (from an average $25,000 to an average of $11,700 per fire),
- 64% for manufacturing properties (from $52,500 to $18,700 per fire),
- 66% for selected health care properties that care for the aged or the sick (from $4,800 to $1,700 per fire), and

- 70% for public assembly properties (from $21,800 to $6,500 per fire) (Rohr, 2001).

According to the NFPA's 1995 figures, approximately 72 percent of all structure fires occurred in homes. There were an estimated 320,000 fires in one-family and two-family homes that year, resulting in an estimated dollar loss of $3.615 billion. Another 94,000 fires in multi-family homes caused an additional $649 million loss. Of the $7.62 billion in structure losses for the year, an estimated 56 percent of the damage occurred in homes (Ford, 1997).

Fire department expenses affect both local governments and residents of the community simultaneously. *Managing the Fire Service*, which is published by the International City Managers Association (ICMA), states that, "As part of the management options, requiring fire alarm systems and sprinkler systems are a viable method of addressing problems beyond the fire department's capabilities" (Coleman & Granito, 1988). The Insurance Services Office (ISO) regularly performs grading surveys in communities and districts that have public fire protection. According to Hickey's, *Management Options in Fire Protection,* organizations have recognized the benefit of fire sprinkler systems in buildings because they can reduce the community fire flow requirements by as much as 50 to 75 percent. This can translate into a partial reduction in the number of fire engines and personnel required to service a community (Danely, 1996).

Fire departments usually consider that a reasonable staffing level is one that yields enough firefighters to stop a pre-flashover fire and perform related tasks, such as search and rescue, with a reasonable margin of safety for the firefighters. A certain number of tasks must be performed either simultaneously or in a highly coordinated manner, and this requires that enough firefighters and resources arrive at about the same time in order to perform them. NFPA 1710 *Standard for the Organization and Deployment of Fire Suppression Operations Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, recommends that, on an initial full alarm assignment, 14 personnel shall respond if an aerial

device is not used. This initial full alarm assignment must also be deployed within an 8-minute response time 90% of the time (2001).

During high-rise incidents, additional time is needed to get inside the building, transport equipment to the floor below the fire, assign various tasks, and begin firefighting operation. In these situations, an early, aggressive and offensive primary interior attack usually reduces loss of life and property (NFPA 1710, 2001). The dark line on the graph shown in Figure 2 represents a rate of fire propagation, which combines temperature rise and time. It roughly corresponds to the percentage of property destruction. At approximately 10 minutes into the fire incident, the hypothetical room of origin flashes over and extension outside the room begins.

Fire sprinkler systems provide a quick response that can extinguish many fires even before the first responding fire units arrive (RFSI, 2003). Consequentially, set-up times for firefighting can be lengthened and the number of personnel and apparatus can be reduced while the fire is being automatically extinguished or held at an incipient stage.

Community costs are also a predominant factor in the discussion of retrofitting sprinklers. NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*, suggests that an authority with jurisdiction should provide approval and conduct annual inspections. An “authority with jurisdiction” may be “a federal, state, local or other regional department or individual such as a fire chief; fire marshal; chief of prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority” (1996). Depending upon the authority with jurisdiction in the community, the costs associated with providing qualified officials to perform sprinkler system inspections will be ongoing.

A study by Gilman, White & Woodward suggests that communities may save money with mandatory fire sprinkler systems. Installing these systems reduces both the needed water

supply for firefighting efforts and the infrastructure required to administer firefighting capabilities. Cost reductions are possible even though a community may be required to modify their water supply system to meet other requirements that fire sprinkler systems demand (2001).

Communities around the U.S. are also devising ways to limit their overall tax expenditures. Costs for public fire protection (particularly for firefighters' salaries and benefits) have escalated so rapidly that many communities are being forced to reassess strategies and consider alternatives. According to Coleman & Granito, "Many communities have chosen to reduce staffing levels of fire companies, usually below what fire officials believe is safe or adequate. Some are strengthening mutual-aid agreements while others are making use of built-in fire protection devices to limit the fire problem" (1988). A more proactive way to attack fire, according to the National Fire Protection Association, is to place more emphasis on fire prevention and less on suppression efforts (NFPA, 1998).

Presently, the emphasis in U.S. fire departments is on fire suppression over fire prevention. This becomes apparent when reviewing fire department data regarding budget allocations and staffing patterns. The National Fire Data Center states, "Other industrialized countries typically spend between 4% and 10% of their fire department budgets on fire prevention, whereas the U.S. spends only about 3%". U.S. fire departments want to maintain their response capabilities and not compromise them in any way (FEMA Trends, 1997). This generally results in efforts to prioritize funding in order to enhance emergency response times, rather than to expand levels of fire prevention and public education.

If fire prevention and public education delivery become more important to the community than fire department unit response times, then tangible benefits can be reaped. These tangible benefits can be separated into issues of life safety, property conservation and financial advantages.

According to Rohr, when sprinkler systems were present, the chances of dying in a fire were cut by one-half to two-thirds compared to fires where sprinklers were not present (2001). This simple comparison understates the potential value because all sprinkler systems are lumped together under one class of occupancy and data is limited to fires that are reported to fire departments. “If unreported fires could be included and if complete, well maintained, and properly installed and designed sprinkler systems could be isolated, sprinkler system effectiveness would be seen as even more impressive” (Rohr, 2001).

Probably the most important purpose of a fire sprinkler system is the prevention of injury and deaths. Sprinkler systems activate quickly, giving occupants more time to escape and consequently minimizing injuries and deaths. According to Patrick Coughlin, Director of Operation Life Safety, a public /private partnership whose goal is fire safety states, “Residential fire sprinklers operate quickly enough to stop a fire before a flashover occurs. Without them, the room becomes untenable to life about halfway to flashover” (Koski, 2000).

Flashover is the stage of a fire at which all surfaces and objects are heated to their ignition temperature and flame breaks out almost over the entire surface area (IFSTA, 1998). With the large amount of synthetic materials in residential structures, fires burn considerably hotter and grow more quickly.

The city of Scottsdale, Arizona instituted a sprinkler ordinance in 1986 that required fire sprinkler systems to be installed in all new single-family homes. The results of this ten-year study documented that fire damage over that time period was significantly reduced and irrefutable evidence was presented revealing that eight lives had been saved by the residential sprinkler systems since the adoption of the ordinance (Ford, 1997).

The BRANZ Resource Center has performed extensive research on residential sprinkler systems in New Zealand, for Building Excellence. The BRANZ 2000 report concluded that the

number of deaths that would occur in homes without sprinkler systems was about 6 in 1,000 fire incidents. This number would be reduced to 1.2 in 1,000 incidents if sprinkler systems were present. Likewise, fire-related injuries would be reduced from 40 to 15 injuries per 1,000 fire incidents (Duncan and Wade, 2001). This data would suggest that the number of deaths and injuries could be reduced by the presence of residential sprinkler systems.

In Scottsdale, Arizona, property loss has been shown to be drastically reduced when fire sprinklers are present and activate during a fire. On April 19, 1982, five fire scenarios were enacted in two similar residential structures. A total of nine fires were conducted in the living room, kitchen and bedrooms. Fires were duplicated with and without fire sprinkler systems in these two houses. One fire was aborted due to a malfunction of the ignition device. All fires were videotaped and provided witnesses with real time live footage. All data was compiled by Factory Mutual and Sentry Insurance companies (Ford, 1997).

At the conclusion of this exercise, it was estimated that there was a property savings of 85.17% due to the ability of the fire sprinklers to control the incidents. The property loss in the sprinklered fires was estimated at $17,200. The estimated loss without the sprinklers was about $116,000, which translates to a $98,000 difference. Only two sprinkler heads, or fewer, controlled eight of the nine fires (Ford, 1997).

Ten years after Scottsdale, Arizona implemented their fire sprinkler ordinance, 18 single-family home fire incidents resulted in an average fire loss per sprinklered incident of $1,689, compared to non-sprinklered costs of $9,571. The total sprinklered loss was $30,402, while the potential loss was estimated at $5.4 million. During this time period, homeowners' insurance rates were an average of 10% less than rates for similar, non-sprinklered homes (Ford, 1997). The community that supplements fire protection with a sprinkler ordinance garners many benefits, including the prospect of reducing fire department staffing, changes to the local

building code that could save community expenditures, reductions in the loss of life and property, and the resulting lowered insurance premiums.

Because fire sprinkler systems react quickly and keep fires to a minimal size prior to the fire department's arrival, it can be assumed that response times for a full first alarm assignment are not as critical as those for a non-sprinklered building. According to the Residential Fire Safety Institute, many fires are extinguished by sprinkler systems even before the first responding apparatus arrives. Responders are only needed for report writing, putting the sprinkler system back in service and reset alarm systems. Therefore the number of firefighters needed to respond to a fire in a United States home with a fire sprinkler system could be reduced by as much as one-half. This reduction in personnel in turn would reduce the number of firefighting apparatus per incident (2003).

Reductions in firefighters, apparatus and fire stations would also lower communities' overall infrastructure costs. It was projected that the city of Scottsdale would be able to reduce its fire department by three stations, thus saving $6 million in capital costs and $1 million in annual costs (Koski, 2000). In 1995, after Scottsdale's 10 year study was complete, there were 8 fire stations in the city; fewer than would normally be expected, given that the population was approximately 175,000 people (Koski, 2000).

Other financial advantages afforded by simply providing fire sprinkler protection include tax breaks and reduced insurance premiums. Florida State Statute 627.0654 *Insurance Discounts for Buildings with Fire Sprinklers*, mandates insurance discounts for buildings with these systems. "The discount required must provide a premium rate that is lower than that for a building in which a fire sprinkler system has not been installed" (2002). Buildings with automatic sprinkler systems will warrant a discounted insurance rate whether the system was installed during construction or retrofitted at a later date. But the current legislation is vague and

allows insurance companies to decide what discounted rate applies, as long as it is lower than the rate for unsprinklered buildings.

Insurance discounts for homeowners now range between 5-15%, with a projected increase in available discounts (FEMA, 1997). According to Dewar, insurance companies factor water damage costs into the amount of the insurance reduction provided for different occupancies. Some commercial properties can receive as much as a 75% reduction in insurance rates, while single family homes can average about a 10% reduction (2001). Both figures were derived from the cost of repairing water damage, which is significantly less than the cost of fire damage repairs.

Some communities, such as Hallandale Beach, assess an annual fire service fee to pay for apparatus and equipment. Since fire sprinkler systems can reduce the demand placed on fire departments, some communities have considered reducing the fire assessment as an incentive to get sprinklers installed (RFSI, 2003). The Residential Fire Safety Institute states that jurisdictions that levy fire assessments through property taxes will sometimes eliminate the fire sprinkler system's value when calculating property tax. Other communities may even give a straight percentage of property tax as rebates for buildings with sprinkler systems (2003).

Even with a vast amount of available information regarding the life-saving attributes, property conservation and financial incentives that fire sprinkler systems afford, occupants of high-rise buildings and governmental entities are still reluctant to install or require the installation of fire sprinkler systems in residential structures.

Since September 30, 1983, the State of Florida has required that new buildings over 75 feet in height, that are used as a motel, hotel or timeshare, must have a sprinkler system that is compliant with National Fire Protection Association standards. On January 1, 1994, the legislation was changed to include any new building having three floors or more, regardless of

occupancy, except for single-family and two-family dwellings. These buildings must be built with an approved fire sprinkler system in compliance with NFPA 13R, *Standard for Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height.* As of July 1, 2001, Florida legislators adopted NFPA 1, *Fire Prevention Code* and NFPA 101, *Life Safety Code* as Chapter 633.0215. *Florida Fire Prevention Code.* The State Fire Marshal has the power to update the Florida Fire Prevention Code every 3 years, using the most recent edition of NFPA 101, *Life Safety Code.* He or she may make adjustments after considering changes made by national model fire codes, the State Fire Marshal's own interpretations, declaratory statements, appellate decisions, and approved statewide and local technical amendments (Fire Prevention Code, 2001).

The fire code adopted in Florida state that, "High-rise buildings shall be protected throughout by an approved supervised automatic sprinkler system and a sprinkler control valve and a waterflow device shall be provided for each floor" (Fire Prevention Code, 2001). This has become an unfunded mandate to the owners of older high-rise buildings throughout the State of Florida who must, within 12–years, install fire sprinkler systems and upgrade existing fire protection systems. The only exceptions permitted apply to buildings that provide exterior access to every dwelling (via catwalks and connected balconies), or have an approved Engineered Life Safety System.

Engineered Life Safety Systems are not clearly defined by the Florida Fire Prevention Code, but they typically consist of:

1. Partial automatic sprinkler protection,
2. An integrated smoke detection and alarm system, and
3. A system of fire-rated compartmentalization (fire rated doors, fire rated walls, self-closing mechanisms, elevator recalls, etc.) to help restrict fire from spreading.

This system must provide a level of protection equal to or greater than a full sprinkler system.

The Florida's Fire Prevention Code states that, "Each building owner shall, within 180 days of receiving notice, file an intent to comply with this regulation with the authority having jurisdiction for approval. The authority having jurisdiction shall review and respond to the intent to comply within 60 days of receipt" (2001).

Beginning in February 2002, the City of Hallandale Beach sent notifications out to 38 high-rise buildings that were affected by the new fire prevention code. Representatives from all 38 buildings returned letters to provide information concerning the chosen method of compliance and a general compliance timeline. The local fire department then responded back to acknowledge the intent to comply. Buildings were expected to have fire sprinkler systems and fire protection system upgrades completed within 12 years. The twelve-year timeframe would allow building owners to budget for such a large expenditure. Of the three examples of related costs, given in a memorandum from Chief D. P. Sullivan, #8A/98, the average price for system upgrades was $686,221.

On March 4, 2003, the Florida State legislative session convened its 60-day session. Two bills addressing high-rise buildings were considered. One bill went to the House of Representatives (H.B. 165) and the other went to the Senate (Online Sunshine, 2003). The House bill attempted to exempt all buildings constructed on or before January 1, 2002, while allowing local authorities to grant exemptions within their jurisdictions. The other bill would allow condominiums and cooperative associations to opt out of the sprinkler system retrofitting requirements if agreed to by two-thirds of the association's total voting interests.

On May 21, 2003, Governor Jeb Bush signed into law a final bill allowing high-rise buildings to opt out of the requirements that the Florida Fire Prevention Code rendered. Senate Bill 592, in its final version states,

Notwithstanding the provisions of chapter 633 or any other code, statute, ordinance, administrative rule, or regulation, or any interpretation of the foregoing, an association, condominium, or unit owner is not obligated to retrofit the common elements or units of a residential condominium with a fire sprinkler system or other engineered life safety system in a building that has been certified for occupancy by the applicable governmental authority, if the unit owners have voted to forego such retrofitting and engineered life safety system by the affirmative vote of two-thirds of all voting interests in the affected condominium. (Online Sunshine, 2003)

The law goes on to say that common areas in high-rise buildings must be retrofitted and the local jurisdiction having authority cannot demand this work be done before the end of 2014. Common areas include enclosed hallways, corridors, lobbies, stairwells, and entryways (Online Sunshine, 2003).

On April 11, 2003, the U.S. House of Representatives introduced legislation that will provide a substantial tax benefit to building owners who install or retrofit property with fire sprinklers (Fire Sprinkler Incentive Act, 2003). The bill amends the 1986 Internal Revenue Code to classify fire sprinkler systems as a five-year property for the purpose of depreciation. This short period of depreciation has the potential to encourage the retrofitting of fire sprinklers on existing depreciable property by offering quicker pay back. According to the National Fire Sprinkler Association, if this legislation passes, a fire sprinkler system that cost $100,000 can be depreciated at $44,000 in the first year and the remainder can be deducted over the balance of the five years (2003). Under the current tax code, full depreciation can take up to 39 years in some cases.

Senator Jon Corzine (D-NJ) introduced S. 1566, the Fire Safety Incentive Act of 2003, on August 4, 2003. This is a companion bill to H.R. 1824, and it would also provide a tax incentive

for building owners who install fire sprinkler systems. The benefit of increased employment relating to the installation of fire sprinkler systems, together with an increased production of materials to meet this new market can be considered as an economic stimulus, which creates new economic growth for local communities (Fire Sprinkler Incentive Act, 2003).

Procedures

This research project employed a descriptive research methodology using a literature review, survey instrument (Appendix B), and interviews to answer the following questions:

(a) What are the costs to the occupants and the community to retrofit fire protection sprinkler systems in high-rise buildings?

(b) What are the benefits to the occupants and the community to retrofit fire protection sprinkler systems in high-rise buildings?

(c) What steps are necessary to implement and comply with Florida's Fire Prevention Code regarding retrofitting fire protection sprinkler systems in high-rise buildings?

The literature review was initiated at the National Fire Academy's Learning Resource Center (LRC) during March 2003. The researcher targeted trade journals, magazines, textbooks, and Internet resources. Many of the applicable resources were summarized and included in the Literature Review section of this report. Additional searches were conducted on-line through Internet search engines to identify published documents, web sites, organizations, and newsletters with content relative to the cost, benefits and implementation of retrofitting sprinkler systems in high-rise buildings.

A cover letter (Appendix A) was sent out with a sample survey (Appendix B), to gather information from condominium associations that would identify support or objections to the objective of retrofitting fire sprinkler systems in high-rise buildings. This sample survey was sent to the 38 high-rise buildings located in Hallandale Beach. They were identified by the local

jurisdiction having authority and the researcher as all the buildings, of 75 ft or more, that are affected by the current state law requiring changes to fire protection systems. Of the 38 sample surveys sent out, 11 were returned. This equates to a 29% response.

Along with the sample surveys, 2 interviews were conducted with fire prevention specialists who have expertise in local, state and national laws pertaining to fire protection devices. Personal interviews were arranged with:

Anthony " Tony" Bruno, Fire Marshal for Cooper City Fire-Rescue Department

Robert "Bob" Growick, Fire Marshal for Hallandale Beach Fire-Rescue Department

The purpose of these interviews was to gain background information and personal knowledge about fire protection sprinkler systems. In addition to the interviews, questions from the sample survey (Appendix B) were also posed to the Fire Marshals.

Definitions and Clarifications of Selected Terms

NFPA - The National Fire Protection Association. Contrary to the belief of many, this organization is not a federal agency and NFPA standards and codes are not enforceable unless adopted by an authority in a particular jurisdiction. The NFPA is the leading fire safety information resource in the world.

Engineered Life Safety System – A system that typically consists of a partial sprinkler system, integrated fire alarm system components, fire rated corridors and entry doors, self-closing mechanisms, and an elevator recall system. A certified engineering firm designs this type of system.

Limitations

The sample survey made several assumptions and had limitations. The first assumption was that, because of the massive amount of media coverage during the current year (2003) concerning legislative intentions, respondents of the survey instrument would understand the issues of retrofitting high-rise building with fire sprinkler systems and be familiar with specific terms.

Another assumption was that respondents would answer questions negatively to retrofitting fire sprinklers and that requiring fire sprinkler systems and other upgrades to high-rise buildings would be perceived as attempts to saddle dwelling owners with an unfunded mandate. The buildings respondents live in have stood the test of time and were originally designed without fire sprinkler systems.

An obvious limitation to the sample survey is the small number of instruments that were sent out (38). This number is low but it represents the total number of buildings in the City of Hallandale Beach that are required to adhere to the new fire prevention code. Large segments of the population in Hallandale Beach's high-rise buildings are seasonal residents and consist of older adults (age 65 and older). If the sample surveys had been sent out during the tourist season. (November to March), a larger response would be assumed by the researcher.

Results

Research Question 1. What are the costs to the occupants and the community to retrofit fire protection sprinkler systems in high-rise buildings?

The high cost of actually placing fire sprinkler systems in high-rise buildings has been the principal obstacle to the adoption of residential sprinkler ordinances by local governments (Coleman & Granito, 1988). Even though it has been reported in communities such as Scottsdale, Arizona that installation costs have decreased to close to $.50 per square foot, these reports are from communities who placed fire sprinkler systems in new residential homes (Ford,

1997). Retrofitting high-rise buildings with fire sprinkler systems is more time-consuming and therefore more costly. Sixty percent of the cost of sprinkler systems can be attributed to installation (Chicago, 1999). The average cost of retrofitting just fire sprinkler components in existing high-rise buildings in Hallandale Beach was estimated to be $2.35 per square foot, as reported in Chief D. P. Sullivan's Memorandum 8A/98. Data from past fire sprinkler retrofit projects completed in Chicago, Illinois ranged from $2.10 per square foot to $4.75 per square foot. Additional figures from projects in Chicago, Illinois estimated the costs for office occupancies to be $3.00 per square foot and hotels to cost $2.50 to $3.00 per square foot (Chicago, 1999).

The most important reason fire sprinkler systems are installed is the prevention of injury and deaths. The loss of life due to fire in the U.S. is one of the highest in the industrialized world (FEMA Trends, 1997). According to information from the National Fire Incident Reporting System (NFIRS) for the period of 1989 through 1998, the Fire Analysis and Research Division of the NFPA reports an ability of fire sprinkler systems to reduce fire deaths and property loss by a factor of one-half to two-thirds (Rohr, 2001). Hall estimates the cost of a fire-related death to be around $1 to $2 million per statistical life (Hall, 1998).

According to the NFPA, there was a significant reduction of property damage in structures having fire sprinkler systems and 72% of all structure fires occurred in residential occupancies (NFPA, 1998). Data collected by Scottsdale, Arizona suggests that a building with fire sprinklers could have property savings of 85.17% due to the ability of the fire sprinklers to control the incident. Testing done on two similar residential structures showed that property loss in the sprinklered fires was estimated at $17,200, while the estimated loss without the sprinklers was $116,000, a difference of $98,000 (Ford, 1997).

Research Question 2. What are the benefits to the occupants and the community to retrofit fire protection sprinkler systems in high-rise buildings?

Fire sprinkler systems react quickly and keep fires small or extinguish them completely. According to the Residential Fire Safety Institute, many fires are extinguished even before the first arriving responders. This allows for the number of firefighters responding to be decreased by as much as one-half. The reduction of fire fighters in turn would reduce the number of apparatus, thus reducing overall infrastructure costs (RFSI, 2001). Financial benefits afforded by simply providing fire sprinkler protection include tax breaks and reduced insurance premiums. According to FEMA, insurance discounts for homeowners with sprinkler systems now range between 5-15%, and increases in available discounts are projected for the future (FEMA, 1997).

The federal government has recognized the importance of fire sprinkler systems and is currently introducing legislation (H.R. 1824 & S. 1566) that will provide substantial tax benefits to building owners who retrofit fire sprinkler systems in their buildings (Fire Sprinkler Incentive Act, 2003). This tax benefit would reward the increased employment and the increased production of materials that are needed to meet this new market. Economic stimulus would create economic growth for local communities (NFSA, 2003).

Research Question 3. What steps are necessary to implement and comply with Florida's Fire Prevention Code regarding retrofitting fire protection sprinkler systems in high-rise buildings?

Florida's Fire Code, adopted in its entirety NFPA 1 *Fire Prevention Code* and NFPA 101 *Life Safety Code* on July 1, 2001. Under this new legislation, high-rise buildings are required to retrofit fire sprinkler systems or to have an Engineered Life Safety System (Online Sunshine, 2003). Building owners were expected to comply with letters of intent, and the local fire department was responsible for mailing out receipts to building owners. Then, buildings were

expected to have fire sprinkler systems and fire protection system upgrades completed within 12 years. Building owners were given 12 years to comply so that they could budget for the expected large expenditures. In Hallandale Beach, the average cost to retrofit a building with a complete fire sprinkler system and provide for necessary upgrades to the other fire protection devices is approximately $686,221, using the examples in Chief D. P. Sullivan's memorandum 8A/98.

Plans to enforce this legislation have been stopped by occupants of high-rise buildings, lobbyist and state legislators. They feel that the requirement to retrofit older buildings with fire sprinkler systems constitutes an unfunded mandate and they see it as an affront to their basic right to determine where and how they live (Sandler, 2003). The current law that was passed on May 21, 2003 allows the occupants, via a vote of two-thirds of all residents, to determine whether they want a full fire sprinkler system or an Engineered Life Safety System (ELSS). An Engineered Life Safety System consists of a partial sprinkler system, integrated fire alarm system, fire rated corridors and doors, self-closing mechanisms, and an elevator recall system.

Results of the Sample Survey

Thirty-eight surveys (Appendix B) were sent out to building owners, condominium boards, and property management companies. Thirty-six of the buildings are residential high-rise structures and 2 are commercial high-rise office structures. Of the thirty-eight surveys sent out, eleven (29%) were returned. Neither of the high-rise office building owners responded. If they were removed from the survey, it would mean that 30.5% of the respondents reported. Nevertheless, information gained from the survey has been helpful with this research.

- Eleven (100%) of the respondents live in a high-rise building having 10 stories or more.
- Eight (73%) of the respondents believe that sprinklers save lives and 3 (27%) answered maybe.

- Four (36%) of the respondents believe that retrofitting sprinklers systems in high-rise buildings is prudent and wise. Four (36%) answered no and 3 (27%) answered maybe.
- Nine (82%) of the respondents believe that an Engineered Life Safety System (ELSS) is just as effective as a fully-sprinklered building. Two (18%) did not know what an ELSS is.
- Ten (91%) of the respondents believe that leaving the choice of whether to retrofit a sprinkler system or not should be left up to the residents. Only 1 (9%) of the respondents was unsure.
- Eight (73%) of the respondents believe the local fire department is adequately staffed and trained to handle a high-rise building fire. One (9%) answered maybe and 2 (18%) were unsure.

Results of Interviews with Fire Protection Specialists

An interview was conducted with Anthony "Tony" Bruno, who is the Fire Marshal in Cooper City, on June 6, 2003. Mr. Bruno has been with the fire service for over thirty-two years. He served with the Hallandale Beach Fire Department for twenty-two years as a firefighter, driver engineer, and fire inspector. During this time, he gained intimate knowledge about fighting high-rise fires. Mr. Bruno has since retired and is presently working as the Fire Marshal for the Cooper City Fire-Rescue department. Cooper City, Florida is west of Hallandale Beach and has very few high-rise buildings. Mr. Bruno has a second home that is in a high-rise condominium.

The researcher asked the same questions that are found on the sample survey. Generally, Mr. Bruno believes that sprinklers save lives and that one or two sprinkler heads usually extinguishes the fire. He believes that retrofitting sprinklers in high-rise building is very wise

because of the great potential for loss of life and property. On the question of the effectiveness of an Engineered Life Safety System, he believes that they are not as effective as a fully sprinklered building, but “a partially-sprinklered building is better than none”. Mr. Bruno stated that, “Giving residents twelve years to comply with the current law helps lessen the financial impact on people that are generally on a fixed income”.

Another interview was held with Robert “Bob” Growick, Assistant Fire Marshal, Miramar Fire-Rescue on June 30, 2003. Mr. Growick served the Hallandale Beach fire service for twenty-two years. For nineteen of those years, he worked in the prevention bureau as a fire inspector and then advanced to the position of Fire Marshal. Mr. Growick retired from Hallandale Beach on July 9, 2003 and is presently working as the Assistant Fire Marshal for Miramar Fire-Rescue. The City of Miramar, Florida is also west of Hallandale Beach and has numerous residential and commercial high-rise buildings. In Hallandale Beach, Mr. Growick was responsible for, and personally conducted, annual alarm testing, standpipe testing and high-rise fire drills.

The researcher asked the same questions found on the sample survey. To summarize this interview, Mr. Growick also believes that fire sprinklers save lives and property. He stated, “Ninety-six percent of the time, activated sprinklers will allow residents to exit safely and keep fire in check”. Mr. Growick believes that retrofitting fire sprinkler systems is a prudent and wise investment. “ For example, state laws allow for benefits such as decreased insurance premiums in buildings with fire sprinklers and increased property values.” Mr. Growick also believes that an Engineered Life Safety System is less effective than a fully sprinklered building. “Although, any partial sprinkler system is better than nothing at all”. According to Mr. Growick, whether or not to retrofit a sprinkler system should not be left up to the occupants alone, “because costs will drive the decision and not common sense and facts”.

Discussion

The research revealed strong relationships between costs and benefits. The cost to retrofit high-rise buildings is significant to the resident-owners in Hallandale Beach, many of whom are older adults (age 65 and older) on fixed incomes. Costs to upgrade the fire protection systems in buildings have been the principal obstacle to the adoption of residential sprinkler ordinances by local governments (Coleman & Granito, 1988). Along with these costs is the inconvenience of having workers installing fire sprinkler systems inside the dwellings as well as the common areas.

The cost of injury and death is a serious concern to everyone associated with high-rise buildings. Fires in the home account for a majority of fire deaths, and the U.S. has one of the highest death rates due to fires in the industrial world (FEMA Trends, 1997). In spite of this, high-rise building residents appear to believe that it won't happen to them. If residential sprinklers were installed together with smoke detectors, 82% of fire deaths could be avoided (Ruegg-Fuller, 1984). A more recent study in Scottsdale, Arizona concluded that 98% of deaths would be avoided with sprinklers and smoke detectors an increase of 48% over smoke detectors alone (Ford, 1997).

In 1998, approximately 2,550 older adults were injured and 1,035 were killed as a result of fires. The older adult population represents the highest fire risk group, according to National estimates and NFIRS data. The risk to this population group is more than twice the national average. With older adults, 85% of fire related deaths and 80% of fire related injuries occur in the home. Over the coming decades, as baby boomers enter retirement age, the older population will increase from 12.5 % to nearly 20% of the total U.S. population (FEMA Fire, 2001). As the older adult population increases, it is likely that fire deaths and injuries in this risk group will

also increase. For a risk group that already has the highest potential for fire deaths and injuries, the likelihood of more fire incidents will challenge fire departments nationwide.

Property damage is also significantly reduced when fire sprinkler systems are installed and activate during fires. According to Ford's ten-year study, The average fire loss per sprinklered incident was $1,689, compared to non-sprinklered costs of $9,571. Total sprinklered loss was $30,402, while the total potential loss was estimated at $5.4 million (1997). The inherent value of residential fire sprinklers has not been publicized to any great extent. If a proactive public education drive were instituted at the state and local level, and if residents of high-rise buildings were made aware of the benefits of sprinklers, the trend to retrofit older high-rise buildings could increase.

The benefits that can be derived by retrofitting high-rise building with fire sprinkler systems are reduced property damage, fewer deaths and injuries due to fire, reduced operating costs to the local government, and economic stimulus. With all the current data available, it is hard to argue against the effectiveness of fire sprinkler systems. Currently, there are a number of programs that are addressing the fire problem through engineering, technical assistance, and public education. However, overcoming the direct cost of installing fire sprinkler systems is by far the biggest hurdle.

Congress has proposed the "Fire Sprinkler Incentive Act of 2003", S. 1566. This bill is a companion bill to H. R. 1824, which would provide a tax incentive for building owners who install fire sprinkler systems. Congress has come to the conclusion that fire sprinkler systems dramatically improve the chances of survival of those who cannot save themselves; specifically, older adults and people with disabilities. They contend that most property owners are incapable of upgrading their dwellings in buildings built prior to safety codes due to the financial cost of retrofitting. The Bill that was proposed on April 11, 2003 gives building owners an incentive to

voluntarily retrofit buildings with fire sprinkler systems in order to save lives of building occupants and responding firefighters as well as reduce the costs from property damage (Fire Sprinkler Incentive Act, 2003).

Currently, when installing a fire sprinkler system in a high-rise residential building, the cost of the system is expensed over its depreciable life (27.5 years). This provides a disincentive to install a system because of the long payback term for the investment. The Modified Accelerated Cost Recovery System (MACRS) that Congress proposes will shorten the depreciable lives of assets, particularly fire sprinkler systems, thus giving back a larger tax deduction. The MACRS system with a five-year class life will be available for the installation of fire sprinkler systems in a variety of occupancies including nursing homes, places of assembly, commercial building and high-rise residential buildings (Fire Sprinkler Incentive Act, 2003).

Recommendations

This research identified the costs and benefits that are significant to occupants of high-rise buildings, local governments, fire service organizations, and the communities affected by a lack of fire sprinkler codes and ordinances. By implementing a retrofit fire sprinkler ordinance, the cost of fire sprinkler systems can be reduced because of economy of scale for the installers. Sixty percent of the cost of installing fire sprinkler systems can be attributed to installation alone, but with the use of new materials such as plastic piping and new sprinkler head technology; making installation easier and more affordable can reduce costs. Local, state, and national government representatives should take this into account when proposing legislation.

There is a large amount of data available to support the fact that fire sprinkler systems definitely help to save lives and property. This information should be made available to the public via mechanisms such as mass media, public education, and awareness training. Who better to deliver this vital information to the public but the fire service? With fire prevention

activities almost non-existent when compared to suppression efforts, the fire service must change the paradigm that drives current operations. According to FEMA, the U.S. fire services spend only 3% of their budgets on fire prevention (FEMA Trends, 1997), while staffing levels are being reduced below what is safe or adequate to fight high-rise fires. The importance of allocating resources for fire suppression should not be neglected, especially in a country whose economy is based on large concentrations of combustible materials. Yet, fire departments must find ways to expand levels of fire prevention and public education rather than concentrating on enhancing emergency response efforts.

Any initiative, ordinance or legislation being proposed by local, state, or national government should be embraced by the fire service via a strong vocal advocacy. The future of the fire service is not just about putting fires out, but about responding to all types of emergency incidents, man-made or natural and to prevent deaths and injuries by providing public education and awareness training to the community.

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Appendix A

January 16, 2007

«Title»
«Company»
«Address1»
«City»«State»«PostalCode»

Dear Sir or Madam:

I am a Battalion Chief who has worked for the City of Hallandale Beach, Florida for over 18 years. I am enrolled in the Executive Fire Officers Program that is administered by the Federal Emergency Management Agency (FEMA) and the United States Fire Administration (USFA). In order to complete the 4-year educational program I must complete four applied research projects that affect our community. The first project that I am beginning is titled: *RETROFITTING HIGH-RISE BUILDINGS WITH FIRE PROTECTION SPRINKLER SYSTEMS: ANALYZING THE COSTS AND BENEFITS FOR HALLANDALE BEACH, FLORIDA.*

This applied research project must be submitted within 4 months and a suggestion by my research project evaluator was to incorporate a survey into the research. **Attached to this letter is a brief survey that is strictly for this independent research project and does not reflect the views or opinions of the City of Hallandale Beach and its Fire Department.**

Please take a few moments and complete the survey form. It will provide pertinent data and help in completing this research project. Your help and input is appreciated and will make this research meaningful to both the community and anyone else researching this subject. If you have any questions or comments, I can be reached at 000 000-0000 or emailed at the enclosed address.

Please return the survey in the self addressed stamped envelope by May 31, 2003 and thank you for allowing me to serve the community.

Sincerely,

Art Bousquet
Battalion Chief
City of Hallandale Beach
Fire-Rescue

Appendix B

Survey for Applied Research Project

Retrofitting High-rise Buildings With Fire Protection Sprinkler Systems: Analyzing The Costs and Benefits For Hallandale Beach, Florida

1. Do you live in a high-rise condominium of 10 stories or more?

   Yes___ No____

2. Do you believe that fire sprinklers save lives?

   Yes___ No____ Maybe_____

3. Do you think that retrofitting sprinkler systems in high-rise buildings is a prudent and a wise investment?

   Yes___ No____ Maybe _____

4. Do you believe that an Engineered Life Safety System is just as effective as a fire sprinkler system?

   Less effective _____ More effective _____ As effective__

   What is an Engineered Life Safety System? _____

5. Do you think leaving the choice of whether to retrofit a sprinkler system or not, should be left up to the residents of a high-rise building?

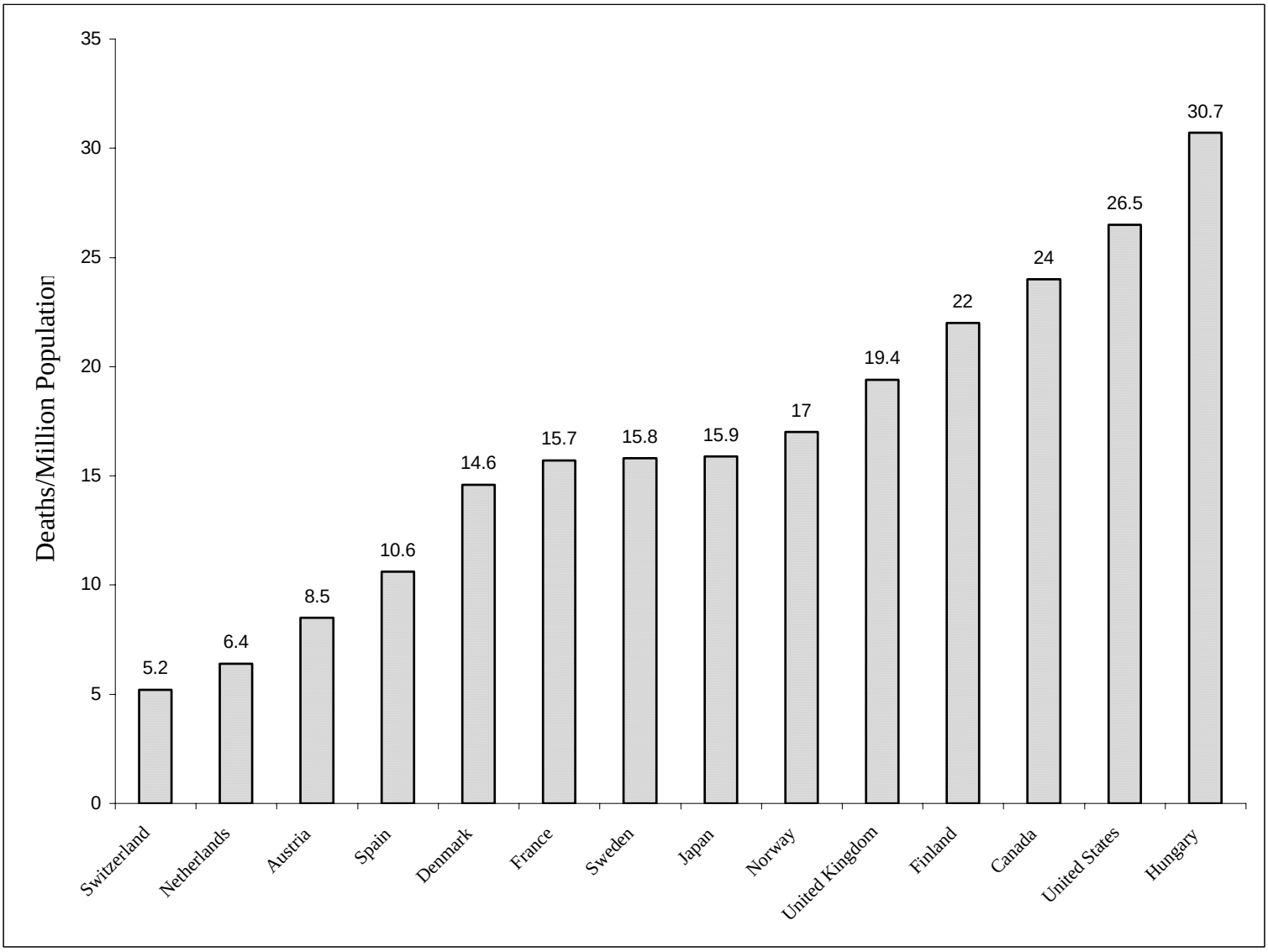
   Yes___ No____ Maybe _____ Unsure _____

6. Do you believe the local fire department is adequately staffed and trained to handle a high-rise fire in your building(s)?

   Yes___ No____ Maybe _____ Unsure _____

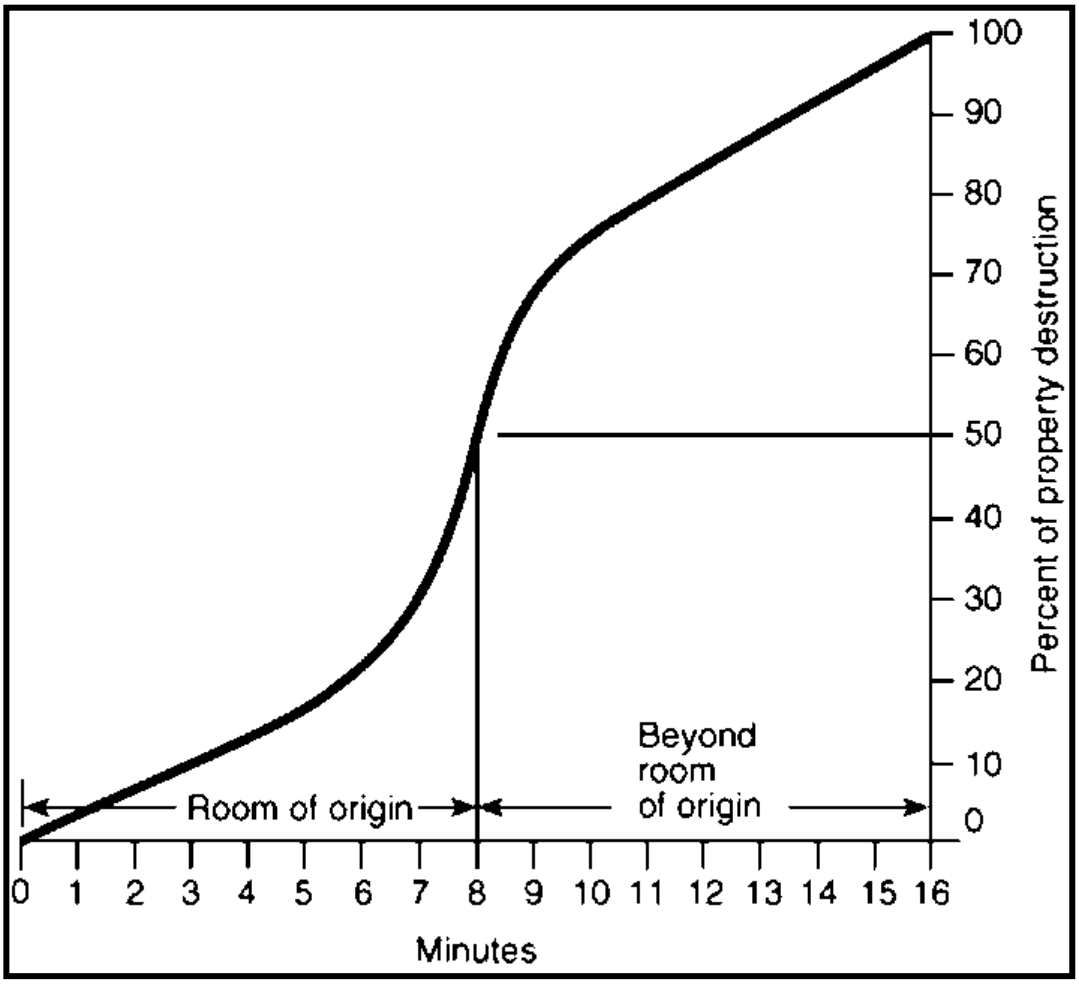
   In the space below please write any comments, concerns or information that would be pertinent to this survey. All of the comments would be helpful to this research and will be appreciated. Please make additional copies of this survey if needed and please send back by June 30, 2003.

Figure 1. Fire Death Rates By Country, 1979-1992



Source: Federal Emergency Management Agency, 1997

Figure 2. Fire Propagation Curve



Source: NFPA 1710, Annex A